CCMC Scoreboards

Slides adapted from Dr. Leila Mays

CCMC community scoreboards

https://ccmc.gsfc.nasa.gov/challenges/

Leads: **Trinity College Dublin** (S. Murray), **ROB** (J. Adries)

Leads: **BIRA-IASB** (M. Dierckxsens, N. Crosby), **GSFC** (I. Richardson), **UK Met Office** (M. Marsh)

Leads: **CCMC** (L. Mays), **UK Met Office**

Leads: **GSFC** (N. Savani), **PredSci** (P. Riley), **CCMC** (L. Mays)

- Collecting and displaying event forecasts from multiple models into **Scoreboards**
- Fostering world-wide **community validation projects** that ultimately help researchers **improve** their CME, flare, and SEP forecasts and determine their **usefulness**.
- Allow a consistent **real-time** comparison of various operational and research forecasts. Complementary to non-real time model assessments.
- The flare and SEP scoreboards are **automated** such that model developers can routinely upload their predictions.
- Forecast data is parsed and stored in a **database** accessible to anyone via an **API**.

CME Arrival Time Scoreboard

Community predictions for the 6 Sep 2017 CME

CME: 2017-09-06T12:24:00-CME-001

Actual Shock Arrival Time: 2017-09-07T22:30Z

Observed Geomagnetic Storm Parameters:
Max Kp: 8.0
Dst min. in nT: -142
Dst min. time: 2017-09-08T02:00Z
CME Note: Associated with X9.3 flare from AR 12673.

Predicted Shock Arrival Time	Difference (hrs)	Confidence (%)	Submitted On	Lead Time (hrs)	Predicted Geomagnetic Storm Parameter(s)	Method
2017-09-08T06:00Z (-3.0h, +3.0h)	7.50	80.0	2017-09-07T05:00Z	17.50	Max Kp Range: 5.0 - 8.0	WSA-ENLIL + Cone (Met Office)
2017-09-08T06:00Z (-2.0h, +2.0h)	7.50	----	2017-09-07T16:30Z	6.00	----	Ooty IPS
2017-09-08T07:32Z (-5.0h, +6.0h)	9.03	----	2017-09-07T08:33Z	13.95	----	DBM
2017-09-08T08:00Z (-3.0h, +3.0h)	9.50	70.0	2017-09-07T05:40Z	16.83	----	DBM + ESWF
2017-09-08T10:16Z (-4.0h, +4.0h)	11.77	----	2017-09-07T09:00Z	13.50	----	EAM (Effective Acceleration Model)
2017-09-08T10:25Z	11.92	----	2017-09-07T02:13Z	20.28	----	SARM
2017-09-08T10:42Z	12.20	----	2017-09-07T15:55Z	6.58	----	SPM
2017-09-08T12:46Z	14.27	84.0	---	---	Max Kp Range: 4.33333 - 6.5	Average of all Methods
2017-09-08T13:00Z (-7.0h, +7.0h)	14.50	90.0	2017-09-07T08:25Z	14.08	Max Kp Range: 5.0 - 7.0	Other
2017-09-08T13:52Z	15.37	----	2017-09-07T15:46Z	6.73	----	SPM2
2017-09-08T15:48Z (-9.0h, +10.0h)	17.30	100.0	2017-09-07T14:53Z	7.62	Max Kp Range: 4.0 - 6.0	Ensemble WSA-ENLIL + Cone (GSFC SWRC)
2017-09-08T16:00Z	17.50	----	2017-09-09T12:59Z	-38.48	----	WSA-ENLIL + Cone (BoM)
2017-09-08T16:30Z (+14.0h)	18.00	----	2017-09-07T12:32Z	9.97	----	ElEvo
2017-09-08T17:00Z (-12.0h, +12.0h)	18.50	80.0	2017-09-06T22:40Z	23.83	Max Kp Range: 4.0 - 6.0	Other (SIDC)
2017-09-08T18:27Z (-7.0h, +7.0h)	19.95	----	2017-09-06T17:23Z	29.12	Max Kp Range: 3.0 - 5.0	WSA-ENLIL + Cone (GSFC SWRC)
2017-09-08T22:00Z	23.50	----	2017-09-06T23:24Z	23.10	Max Kp Range: 5.0 - 7.0	WSA-ENLIL + Cone (NOAA/SWPC)

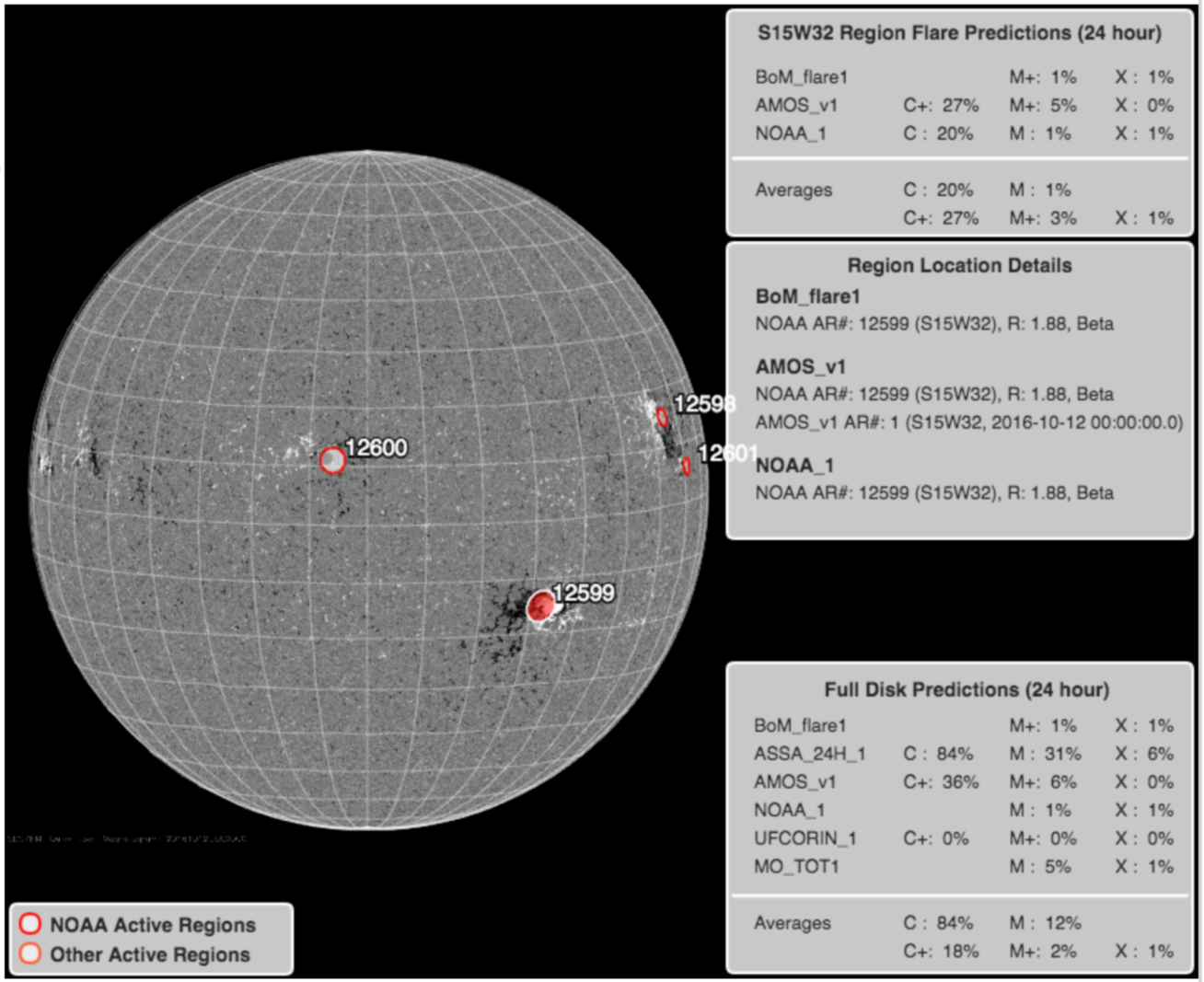
https://kauai.ccmc.gsfc.nasa.gov/CMEscoreboard

All prediction methods are welcome and all are encouraged to participate.

Flare Scoreboard

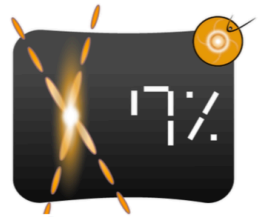
https://ccmc.gsfc.nasa.gov/challenges/flare.php

- Allows a consistent real-time comparison of various operational and research flare forecasts.
- Automated system; model developers can routinely upload their predictions to an anonymous ftp
- Forecast data is parsed and stored in a database which accessible to anyone via an API
- This project is led by Sophie Murray (TCD) and the planning group includes expert scientists as well as operational space weather prediction centers.

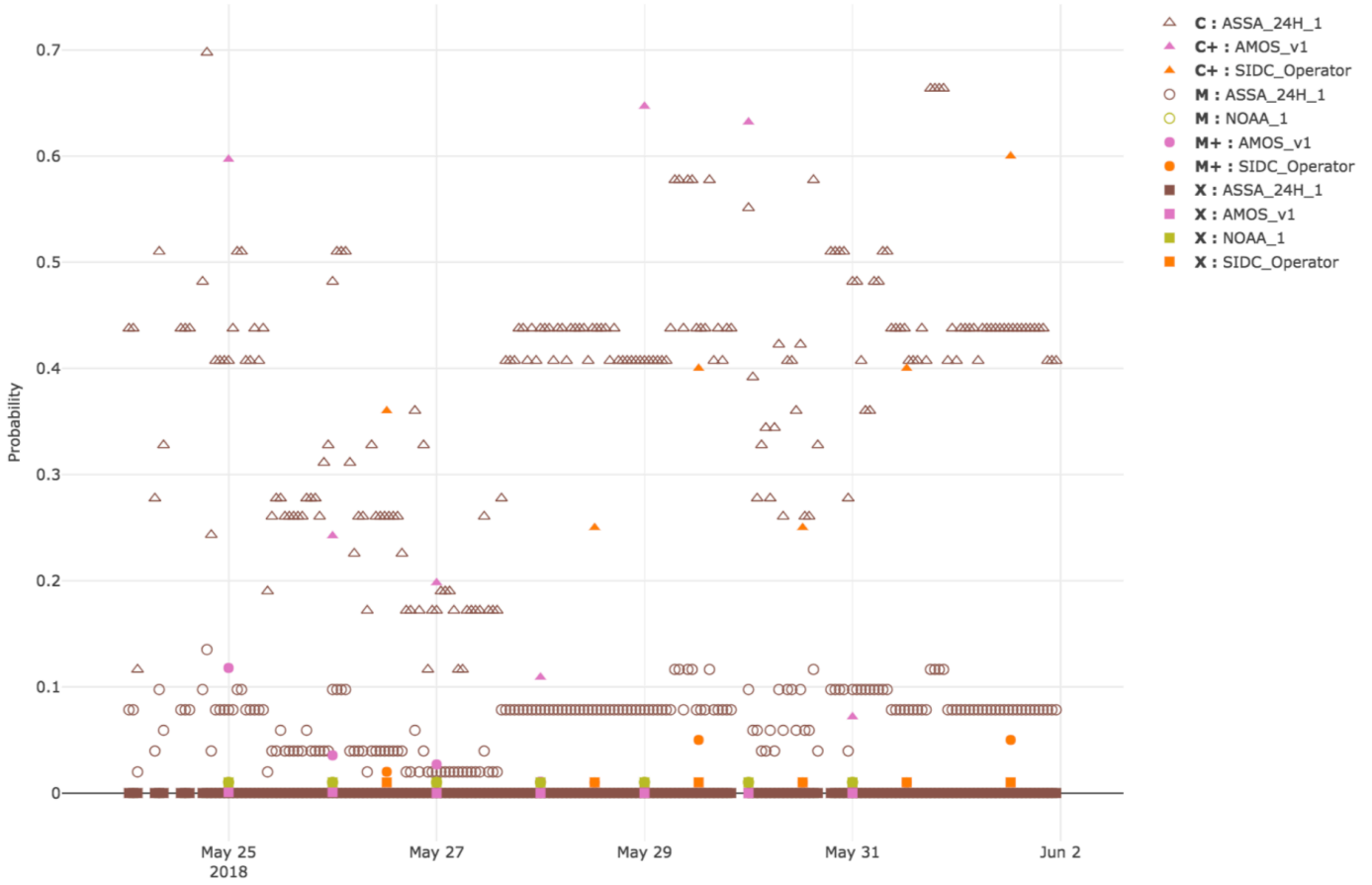


Flare Scoreboard

https://ccmc.gsfc.nasa.gov/challenges/flare.php



Full Disk 24 Hour Predictions



Start time (and issue time) of 24-hour prediction window

SEP Scoreboard

https://ccmc.gsfc.nasa.gov/challenges/sep.php

- Planning for the SEP Scoreboard has started (led by BIRA-IASB, GSFC, UK Met Office)
- Builds upon the flare scoreboard and CME arrival time scoreboard
- Automated system; model developers can routinely upload their predictions to an anonymous ftp. Forecast data will be parsed and stored in a database which accessible to anyone via an API
- SEP forecasts can be roughly divided into three categories:

- The SEP scoreboard will focus on real-time forecasts (first and second categories) and will collect: proton flux profile, threshold crossing probability, onset time, and duration.
- The SEP scoreboard team will also coordinate with the SEP Working Team for historical comparisons, particularly for those physics-based models in the third category that are not ready or relevant for real-time modeling.

Integrated Solar Energetic Proton Alert/Warning System (ISEP)

A Joint SRAG/CCMC Collaboration to Improve Space Weather Prediction for Crew Protection during Near-Term Lunar Surface and Cis-Lunar Missions

- As human spaceflight goals extend from Low-Earth Orbit (LEO) missions like the International Space Station to the moon, Mars and beyond, the Space Radiation Analysis Group (SRAG) at Johnson Space Center needs to update their approach for mitigation of crew radiation exposure due to large Solar Particle Events (SPEs).
- The Integrated Solar Energetic Proton Event Alert/Warning System (ISEP) represents a collaboration between SRAG and the Community Coordinated Modeling Center (CCMC) at Goddard Space Flight Center to bring state-of-the-art space weather models from research and development at universities and small businesses to operational use at NASA (R2O).
- These models will have a user interface in the form of the SEP Scoreboard that will allow the SRAG console operator to view and compare the results from several different models simultaneously; this approach also encourages the console operator to understand the background and associated caveats of each model in order to formulate the best crew response to changes in the space weather environment.

SEP Scoreboard

Proton Probability Forecast - Heat Map & Time Series

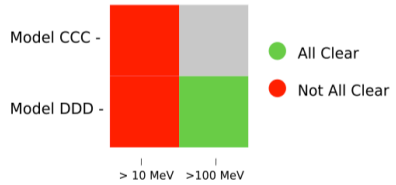
12/18/2018 12:00 UT

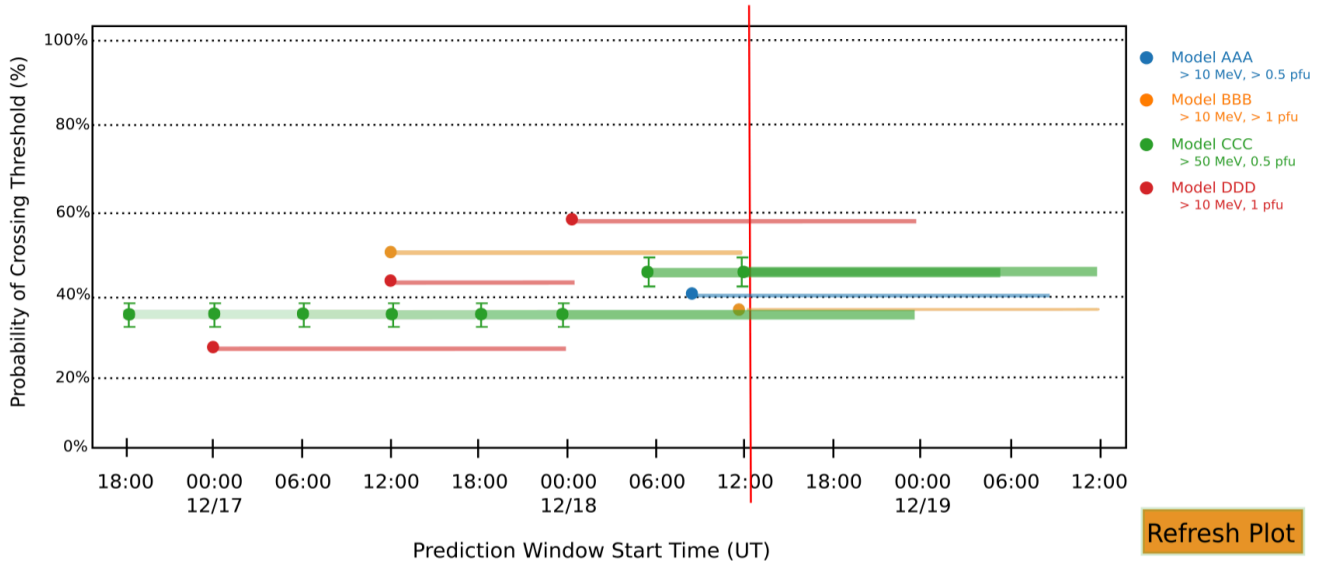
Probability Forecasts:
2018-12-18 12:00 UTC

	> 10 MeV > 10 pfu	>100 MeV > 1 pfu
Model AAA	39	30
Model BBB	37	NA
Model CCC	42	NA
Model DDD	58	47
Averages	44	38

Probability of Crossing Threshold (%)

All Clear Forecasts:
2018-12-18 12:00 UTC





Download Data

Prediction Window
- 24 Hour
- 12 Hour

Models

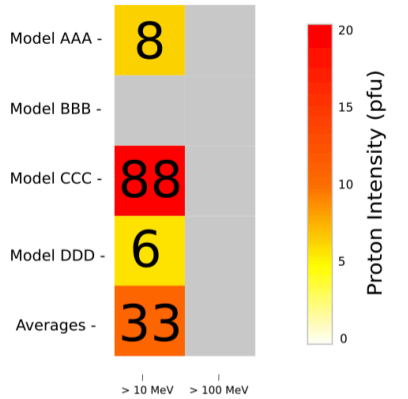
- **Model AAA**
  - > 10 MeV
    - > 0.5 pfu
    - > 1 pfu
    - > 10 pfu
  - > 50 MeV
    - > 0.5 pfu
    - > 1 pfu
    - > 10 pfu
  - > 100 MeV
    - > 0.5 pfu
    - > 1 pfu
    - > 10 pfu
- **Model BBB**
  - > 10 MeV
    - > 0.5 pfu
    - > 1 pfu
    - > 10 pfu
  - > 50 MeV
    - > 0.5 pfu
    - > 1 pfu
    - > 10 pfu
- **Model CCC**
  - > 10 MeV
    - > 0.5 pfu
    - > 1 pfu
    - > 10 pfu
- **Model DDD**
  - > 10 MeV
    - > 0.5 pfu
    - > 1 pfu
  - > 100 MeV
    - > 1 pfu
    - > 10 pfu
- **Model EEE**
  - > 100 MeV
    - > 0.5 pfu
    - > 1 pfu

SEP Scoreboard

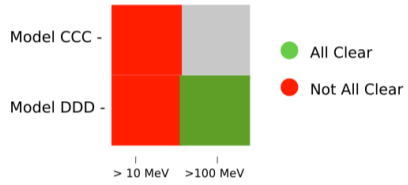
Proton Intensity Forecast

2018-12-18 10:00

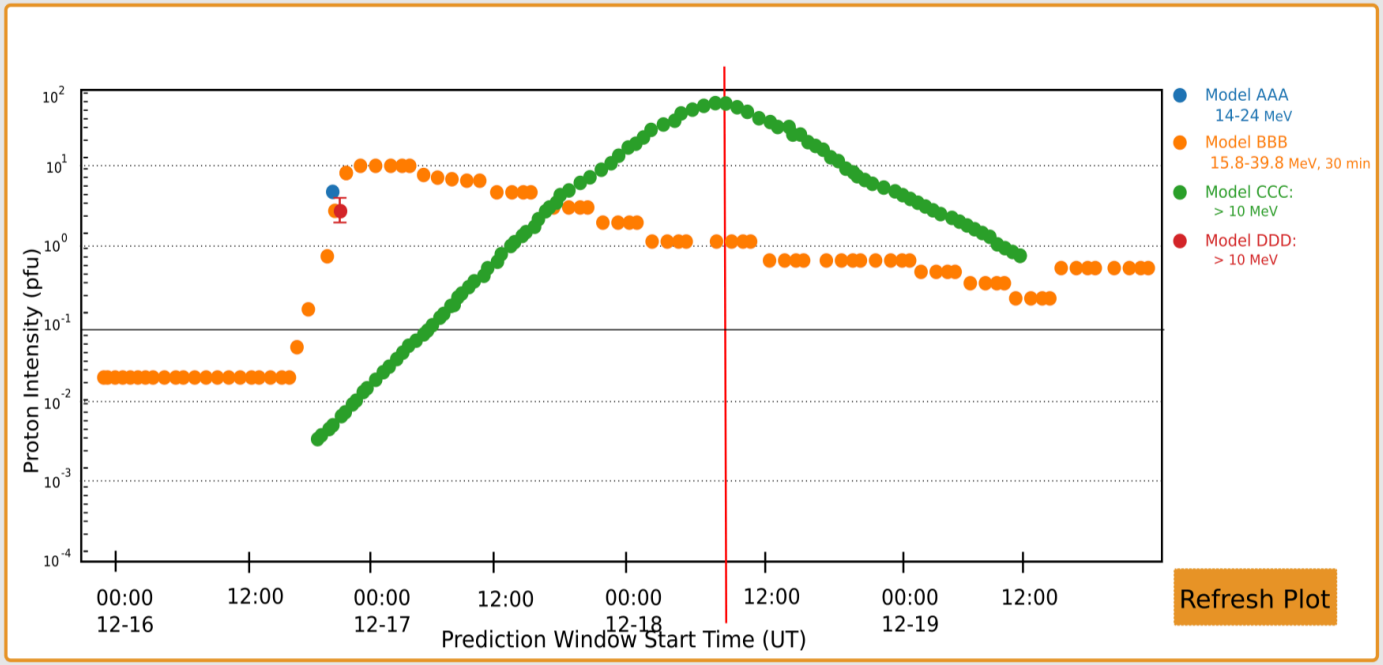
Peak Intensity Forecasts:
2018-12-18 10:00 UTC



All Clear Forecasts:
2018-12-18 10:00 UTC



Download Data



Models

- **Model AAA**
  - [x] > 10 MeV
  - [x] 14-24 MeV
- **Model BBB**
  - [x] 15.8-39.8 MeV
    - [x] 30 minutes
    - [ ] 60 minutes
    - [ ] 90 minutes
  - [ ] 28.2-50.1 MeV
    - [ ] 30 minutes
    - [ ] 60 minutes
    - [ ] 90 minutes
- **Model CCC**
  - [x] > 10 MeV
  - [ ] > 30 MeV
  - [ ] > 50 MeV
  - [ ] > 60 MeV
  - [ ] > 100 MeV
  - [ ] > 300 MeV
- **Model DDD**
  - [x] > 10 MeV
  - [ ] > 100 MeV
  - [ ] > 500 MeV
- **Model EEE**
  - [ ] > 100 MeV